VERIFICATION OF DICHOTOMOUS LIGHTNING FORECASTS AT THE EUROPEAN STORM FORECASTING EXPERIMENT (ESTOFEX)

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I. INTRODUCTION

The European Storm Forecast Experiment (ESTOFEX) (Dahl et al., 2004) is a research project of a group of European meteorologists, who intend to learn how to forecast severe convective storms in Europe. The goal is to improve the capability of European meteorologists in general to timely recognize the conditions in which severe convective weather events happen.

ESTOFEX issues *Storm Forecasts* on a daily basis. These bulletins, that are accompanied by a map, address the threats posed by severe convective storms in Europe. The forecasts focus on the threats of hail, severe wind gusts and tornadoes that these storms pose. To that aim various threat levels are issued. The forecasts additionally indicate the areas where lightning is expected.

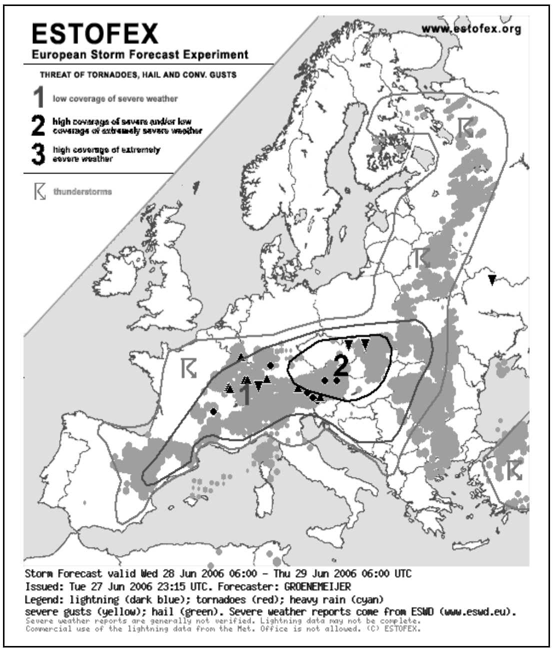

FIG. 1: A Storm Forecast graphic. The forecast shows a (the outer, light grey) contour around the areas for which lightning is forecast and contours corresponding to threat levels of tornadoes, large hail and convective gusts. The true lightning observations are indicated by grey circles. The black circles and triangles denote observed heavy rain, hail and tornadic events that are not discussed here.

An essential aspect of weather forecasting is verification: the comparison of the weather that was forecast with that which occurred. ESTOFEX implements verification methods so that the quality of the forecasts can be assessed. Verification also shows where the largest opportunities for improvement exist. For example, the forecasters can use the verification data to see where and when they tend to forecast too frequently or not frequently enough. Being aware of that, they can recalibrate their forecasts and thus improve their quality.

II. FORECAST VERIFICATION METHODOLOGY

The first step in forecast verification taken in ESTOFEX has been an assessment of the lightning areas forecast. *A posteriori*, the criterion that was used as the occurrence of lightning was:

Did lightning occur within a circle of radius 40 km around a point?

The data used for this procedure originates from the U.K. Met. Office's arrival time difference (ATD) lightning detection system (Lee, 1986), which is available to us on a 0.5 by 0.5 degree grid. As 0.5 degrees of latitude corresponds with a grid point distance of about 55 km, this is a rather large distance compared with the criterion. This is thought to have a deteriorating effect on the verification results along the boundaries of the lightning areas. Because the average error of placing the boundaries of lightning areas is much larger than 30-40 km this effect is comparatively small.

		event occurred?	
		Yes	No
Event forecast?	yes	hit ***h***	false alarm ***f***
	no	miss ***m***	quiescent event ***q***

TABLE I: Contingency table.

The verification has been carried out according to the standard method of using a contingency table. For every forecast bulletin, a large number of points scattered across the entire forecast area have been classified as being either a *hit*, a *false alarm*, a *miss* or a *quiescent* (or *null*) event. When the total occurrence of *hits*, *false alarms* etc. during one year are calculated, certain systematic forecasting errors can be revealed and the spatial distribution of forecast quality can be obtained. Based on these data, the following maps show the spatial distribution of the true occurrence of lightning (FIG. 2) and the forecast occurrence (FIG.3). At the conference maps displaying the *false alarm rate* and the probability *of detection* in an approximately one-year period starting 30th of April 2006 will be shown as well.

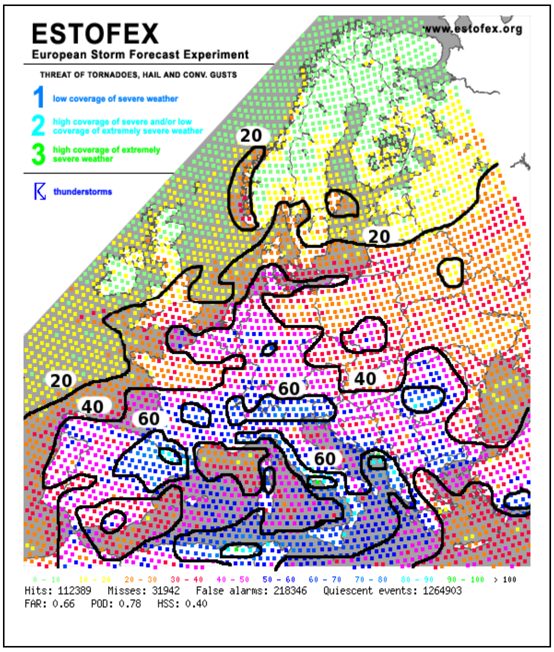

FIG. 2: Observed lightning occurrence in the period 30 April 2006-27 April 2007, or *hits + misses*.

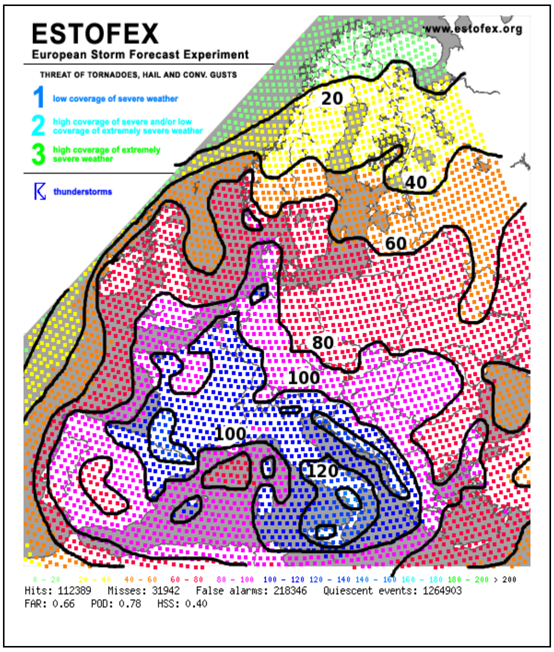

FIG. 3: Forecast lightning occurrence in the period 30 April 2006-27 April 2007., or *hits + false alarms*.

The present results indicate that lightning forecast for certain areas is particularly problematic. Especially in northern Algeria lightning was often missed by the forecasters as well as in northeastern Greece and the Black Sea. Areas with many false alarms include the northwestern Mediterranean, the northwestern British Isles, much of Scandinavia and again, the Black Sea.

III. Conclusions and Outlook

The current method of verification clearly indicates which areas are most problematic for the forecasters and thereby deliver useful information to the forecasters.

The verification has not yet been extended formally to the forecasting of tornadoes, hail and convective wind gusts. This is however planned for the near future.

A different type of forecasting is then required however, because a dichotomous forecast for events like tornadoes and large hailfall are impractical: it is not possible to say that "a tornado *will* occur" within some area within a 24 hour forecast period. Instead, a probability can be given. A probabilistic forecast framework will also be introduced for lightning forecasting during the summer of 2007. First results thereof should be available for presentation at the conference.

IV. Aknowledgments

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V. References

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